THE CLAIMED INVENTION

The present invention, in a first aspect, provides a self-monitoring flow-through heater comprising (a) a passageway providing a flow conduit; (b) a wire disposed in the passageway for heating and monitoring temperature of a fluid flowing through the tube, the wire having a high temperature coefficient of resistance, so that monitoring voltage across and/or current through the wire measures mean temperature of the wire and thereby indirectly of the fluid in the passageway; (c) a current-sensing first resistor, the resistor being electrically connected in series with the wire; (d) a voltage regulator and a first potentiometer, for applying a constant voltage across the wire, voltage drop across the first resistor being directly proportional to the current flowing through the wire, the sensed voltage across the resistor decreasing as the mean temperature of the wire increases, the wire thereby functioning as a temperature sensor; (e) an operational amplifier, for amplifying the voltage sensed across the first resistor; (f) an adjustable voltage divider comprising a fixed second resistor, a second potentiometer, and a comparator, for comparing the amplified voltage with a set-temperature voltage generated by the adjustable voltage divider; (g) a first switch, to provide an additional path to ground for the voltage regulator through a third potentiometer, when the set temperature is reached and the comparator goes high, turning on the first switch, thereby lowering the output voltage applied to the wire by the voltage regulator, whereby the voltage applied to the wire lies between two adjustable values controlled by the first and third potentiometers; and (h) a light-emitting diode and (i) a second switch, for registering point at which the set temperature is reached.

In a second aspect, the invention provides a self-monitoring flow-through heater comprising a passageway comprising (a) a flow conduit; and (b) a straight bare platinum wire disposed in the passageway, for heating and monitoring temperature of a fluid flowing through the passageway, and for catalyzing chemical reactions that are catalyzed by platinum, the wire having a high temperature coefficient of resistance, so that monitoring voltage across and/or current through the wire measures mean temperature of the wire and thereby indirectly of the fluid in the passageway, the wire being coaxially disposed in the passageway, to provide a minimum operating volume.

SCOPE OF THE PRIOR ART

U.S. Patent (Pat.) 6,080,973 to Thweatt, Jr. discloses an electric water heater that includes a polymeric body having an elongated hollow, an inlet opening, and an outlet opening in communication with the hollow, for flowing water to pass therethrough. An electric resistance heater having a heating element of a material exhibiting a positive temperature coefficient of resistance is disposed in the hollow of the polymeric body, and is in heat-transfer communication with water flowing through the hollow. An electrical source supplies electrical power to the heating element to generate heat. A controller senses current flow through the heating element and determines a resistance-related value, such as current or resistance of the heating element. The controller also determines a first derivative of the resistance-related value over a period of time, and controls power supply to the heating element as a function of the first and second derivatives and/or absolute resistance.

U.S. Pat. 4,736,091 to Moe discloses an integral sensor controller for an electrical heater. The heater is constructed from materials such as nickel, Balco, platinum, alumel, or like materials which have an appreciable positive temperature coefficient of resistivity. The resistance-versus-temperature characteristic of the heater acts as the temperature sensor. A low-level direct current provides a sensor voltage which is compared to a set-point voltage for switching the heater power through a transistor. The relationship of the sensor voltage to the set-point voltage is compared by a comparator which is subsequently used to toggle flip-flops for switching of the heater power. Circuitry is provided for protection against heater short circuits.

U.S. Pat. 2,716,179 to Cornella discloses a water-pipe device which is **relatively inexpensive to produce**. Cornella discloses a passageway providing a flow conduit, and a heating **coil** coaxially disposed in the passageway.

THE EXAMINER'S RATIONALE

In rejecting claims 6 – 7 under 35 U.S.C. 102(b) over U.S. Pat. 2,716,179 to Cornella the Examiner states that Cornella discloses a passageway providing a flow conduit, and a wire disposed in the passageway; that it has been held that a recitation with respect to the manner in which a claimed apparatus is intended to be employed does not differentiate the claimed apparatus from a prior-art apparatus satisfying the claimed structural limitations [Ex parte Masham, 2 USPQ2d 1647 (1987)]; and that applicants' claim(s) only require(s) that the wire be capable of performing the given functions.

In rejecting claim 8 under 35 U.S.C. 103(a) over the Cornella patent the Examiner states that Cornella discloses the claimed invention except for the specific use of platinum as the heating-wire material; that Cornella discloses that the wire has a relatively high resistance; and that it would have been obvious to use a platinum heating wire in the device for Cornella, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice (In re Leshin, 125 USPQ 416).